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and V.P. Serebryakov

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MANUAL FOR THE IDENTIFICATION OF REDFISH SPECIES OF THE NORTH ATLANTIC AND ADJACENT AREAS

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and N.I. Litvinenko and
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Edited by Candidate of Biological Sciences A.S. Noskov

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INTRODUCTION

Redfish of the genus Sebastes are an important target of the /4*
international and Soviet fishery in the North Atlantic. In order to study usable stocks, predict catches and regulate the fishery, we must know the species composition of catches and the distribution and migration of populations, estimate usable stocks and give recommendations on the

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fishery for particular species and stocks. Until now, in some regions of the Northwest Atlantic, the redfish S. fasciatus was reckoned together with S. mentella in catches and biological analyses as a single species S. mentella, which led to mistaken conclusions.

This manual is intended for the identification of the species affiliation of larvae, fingerlings and adult redfish of the genus Sebastes in the North Atlantic.

The North Atlantic species of redfish differ little morphologically (this is often observed in the Pacific as well). Their identification is difficult and time-consuming by comparison with many other commercial fish species.

However, the identification of species is necessary. Observations relating to a mixture of species, not discriminated from each other, are meaningless.

The first identifications must be done on the basis of all the control characters listed below (separately for growing and adult individuals, for fingerlings and larvae).

If time is short and it is necessary to study a large number of specimens, the species can be identified by the external appearance alone, without referring each time to control characters. However /5 this can only be done if there is suitable experience, that is, if this quick identification (which is usual for many other fish species) has previously been confirmed by repeated checking against control characters.

Nevertheless, for each sample, whatever its purpose, one must determine the control morphological characters for at least 10 specimens of each species, including the smallest and largest individuals and those of the sizes which predominate in the sample.

Fish size is most often expressed in terms of length. In ichthyology, we use:

1. Absolute length (AL) ["natural tip length"]. In North Atlantic redfish, this is measured from the anterior point of the lower lip to an imaginary line joining the end of the longest ray of the upper part of the caudal fin with the end of the longest ray of the lower part of the second fin.

2. Fork length (FL). In North Atlantic redfish, this is measured from the anterior point of the lower lip to the end of the shortest of the central rays of the caudal fin.

3. Standard length (SL). In redfish, this is measured from the anterior point of the upper lip to the base of the caudal fin at the point where it intersects the lateral line.

In North Atlantic refish, on average Al = 1.165FL = 1. 20SL. The species differ little from each other, especially in the AL/SL ratio.

In applied studies of redfish, FL is most often used, SL in morphological studies.

In identifying the species affiliation of North Atlantic redfish, /6 one should proceed from item I to item III in each of the sections A-F, but item I can be omitted for fishes of North America and item II can be omitted for the coast of Europe, Bear and Spitsbergen islands.

A. IDENTIFICATION OF GROWING AND ADULT INDIVIDUALS WITH FORK LENGTH 12 CM OR MORE

I. Discrimination of the little redfish Sebastes viviparus Kroyer.

The best control character is the number of oblique scale rows.

1. Counting of oblique scale rows. Counted from posterior margin of upper part of pectoral girdle to the base of the caudal fin (Fig. 1).

There are fewer than 55 oblique rows of scales in S. viviparus, more than 55 in other species.

If the scales have been stripped, the scale rows can be counted from the scale pockets. If even these have been removed, and it is not possible to count the number of scale rows, S. viviparus can be identified by other characters, but in this case, a combination of characters must be used. The identification based on scales should also be checked against this combination of characters.

2. Counting of the number of rays in the pectoral fin. The rays are counted by their bases, the upper unbranched rays, branched rays and lower unbranched rays together (in stale fish, the lower unbranched rays may break up along the ray into two halves - external and internal. They cannot both be counted!).

3. Counting of the number of soft rays in the anal fin. There are always three spines in the anal fin in redfish. They are not included in the count. The soft rays are reckoned by their bases, the last two rays, whose bases, unlike those of the other rays, are set immediately adjacent /8 to each other, being counted as one.

4. Determination of the angle of inclination of the lower spine on the preopercle. This angle is measured as the angle between the longitudinal axis of the body (that is the line drawn from the anterior point of the upper lip to the base of the caudal fin at the place where it intersects the lateral line) and the line drawn along the middle of the spine (along the entire spine, if it straight, and along its end part, if the spine is bent). Attention is paid to that segment of the longitudinal axis of the body which is situated behind its intersection with the line drawn along the spine (Fig. 2).

5. Determination of the degree of development of the symphysial tubercle (Fig. 3).

In S. viviparus , there are usually 18 or less rays in the

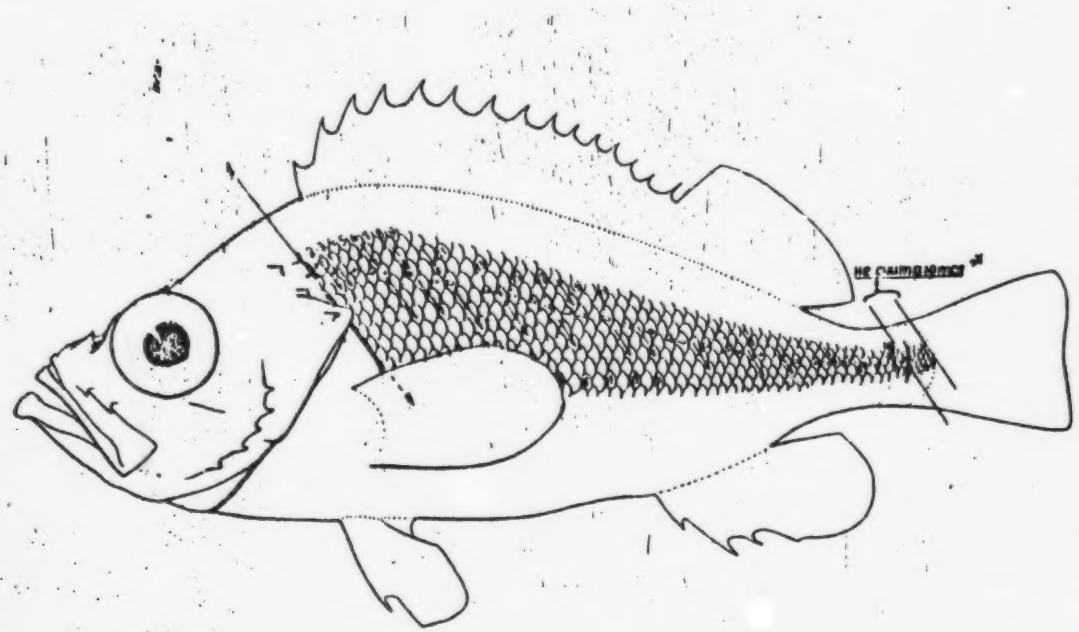

Fig. 1. Oblique rows of scales. They are counted from the row adjoining the pectoral girdle above the pectoral fin to the last row including a neuromast, immediately before the base of the caudal fin.

*not counted.

pectoral fin, 7 or less in the anal fin; the angle of inclination of the lower preopercular spine is less than 45°; the symphysial tubercle is poorly developed. In other species, there are usually 19 or more rays in the pectoral fin and the angle of inclination of the lower preopercular spine is more than 45°.

Individuals in which only one of the characters cited for S. viviparus does not match these values, can be assigned to S. viviparus. If there are two such characters, the individual must be noted and all control characters indicated. It is desirable to count the number of vertebrae.

6. Counting of the number of vertebrae. Done in skinned or on X-ray photograph of whole fish. The vertebrae are counted together with the urostyle (Fig. 4).

In all redfish (not counting very rare anomalies), the interneuralia, in which the 1st and 2nd spines of the dorsal fin are set together, as well as the /12 interneuralia in which the 3rd spine is set, intrude together between the neural processes of the 2nd and 3rd vertebrae (the interneuralias of the other spines, not counting the last one, normally intrude singly). Taking this into account, one can for convenience, begin the count directly with the third vertebra.

In S. viviparus, there are usually 30 vertebrae, with rare exceptions, which are sometimes not found at all even in a hundred specimens. In S. marinus and S. mentella, there are usually 31 vertebrae, 30 being found more often in S. marinus than in S. mentella, 32 less often.

S. viviparus is not found off North America, and is found only rarely off the coast of Greenland. This species, usually in small numbers,

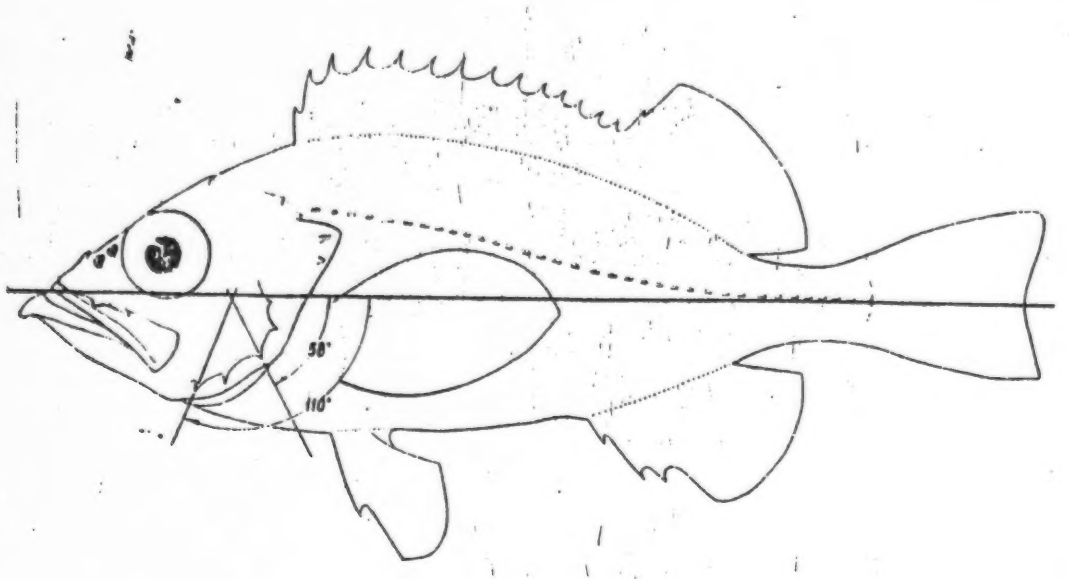

Fig. 2. Angle of inclination of 3rd and lower (5th) preopercular spines.

/10

Fig. 3. Degree of development of symphysial tubercle. In upper row - specimen with least developed, in 2nd row from top - most developed tubercle among individuals of given length interval (by columns). Both series - S. marinus. Columns 15-20 and 23-20 cm also apply to S. viviparus (this species does not reach a greater length). In 3rd row from the top - specimen with least developed, and in 4th row from the top - most developed tubercle among individuals of given length interval in S. mentella (the variations in relative dimensions of the tubercle are very similar in S. fasciatus).

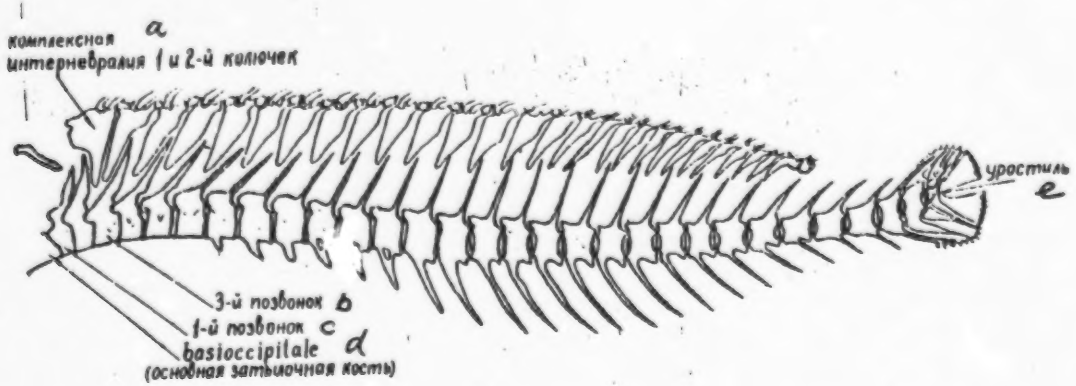

Fig. 4. Vertberal column and skeleton of dorsal and caudal fins.

a - complex interneuralia of 1st and 2nd spines.
b - 3rd vertebra.
c - 1st vertebra.
d - basioccipitale (main occipital bone).
e - urostyle.

enters bottom trawls off Iceland, in the northern part of the North Sea, in the eastern part of the Norwegian Sea and in the west of the southern part of the Barents Sea. In general, it keeps to shallower depths, less than 120 m as a rule, than all the other North Atlantic redfish species, although some individuals can be found right up to depths of 600-700 m.

II. Discrimination of S. fasciatus Storer

In addition to those mentioned above, the following control characters are required:

7. Angle of inclination of 3rd preopercular spine from the top. This is measured as the angle between the longitudinal axis of the body and the line drawn along the middle of the spine (in the same way as the angle of inclination of the 5th spine, see paragraph 4, Fig. 2).

8. Degree of differentiation of the parietal and nuchal crests /13 (Fig. 5). These crests are considered to be fused if there is only one common crest, ending in a spine or a tubercle, and separate, if there are two successive crests, or if there is another spine or tubercle on the single common crest, in front of the spine or tubercle in which this crest terminates.

In S. fasciatus, the symphysial tubercle is strongly developed (see Fig. 3); there are more often 7 or fewer rays in the anal fin; the angle of inclination of the 3rd preopercular spine is less than 40°; the parietal and nuchal crests are separate, if only on one side; and there are 30 or less vertebrae.

In S. marinus and S. mentella, there are more often 8 or more rays in the anal fin; the angle of inclination of the 3rd preopercular spine is more than 40°; the parietal and nuchal crests are fused; and there are 31 or more vertebrae.

In specimens living on the Northern Newfoundland Banks and off Labrador, the rays in the anal fin, and in those on the Nova Scotia Banks, the degree of fusion of the parietal and nuchal crests need not be determined. In the redfish of these regions, these characters show too many transitional values.

Specimens, in which only one of the characters adduced for S. fasciatus does not correspond to the values for this species, can be assigned to S. fasciatus. Fish in which there are two such characters, must be noted specially, indicating all control characters.

S. fasciatus is not found off Europe, Bear and Spitsbergen islands, and is rare off Iceland. It is rarer than S. marinus off Greenland, and rarer than S. mentella outside the fjords. It has not been found off Baffin Island, and is caught more rarely than S. mentella off Labrador. Further south, it predominates increasingly over the other species of redfish, while this species lives /15 practically alone in the Gulf of Maine. It is divided into two subspecies: S. fasciatus kellyi, which lives in the Gulf of Maine in the region of Eastport and vicinity, directly off shore at a depth of several meters, and the widely distributed S. fasciatus fasciatus, which is similar to S. marinus in its distribution by depth.

III. Discrimination of the "golden redfish" S. marinus L. and the deepwater redfish S. mentella Travin

In addition to those mentioned above, the following control characters are required:

9. Depth of the caudal peduncle. This is measured at the narrowest place on the caudal peduncle, perpendicularly to the longitudinal axis of the body.

10. Number of neuromasts on the anterior margin of the occipital commissure, in the portion situated between the parietal crests (Fig. 6). In large individuals, these pores can be seen with the naked eye, but it is better to use a binocular microscope.

In S. marinus, the symphysial tubercle is poorly developed (see Fig. 3). The depth of the caudal peduncle is usually more than 8.8% SL with SL 11-17 cm, more than 9.0% SL with SL 17-25 cm and more than 9.2% SL with SL 25-29 cm. The angle of inclination of the lower preopercular spine is less than 80° in fishes which live in the Barents Sea and vicinity, and less than 105° in those found off Iceland and in the Northwest Atlantic. There are 4 neuromasts between the parietal crests on the anterior margin of the occipital commissure. The coloring is golden-red or orange-red.

The symphysial tubercle is strongly developed in S. mentella. The depth of the caudal peduncle is usually less than 8.8% SL if SL 11-17 cm, less than 9.0% SL if SL 17-25 cm, and less than 9.2% SL if SL 25-29 cm. The angle of inclination of the lower preopercular spine is more than 80° in the /17 fishes of the Barents Sea and adjacent waters, and more than 105° in those living off Iceland and in the Northwest Atlantic. There are 2-3 neuromasts between the parietal crests. The coloring is pinkish-red.

For the fishes of the Barents Sea and adjacent parts of the Norwegian and Greenland seas, it is useful to apply still another character: the number of lower unbranched rays of the pectoral fin, situated below the branched rays. In S. marinus in these regions, there are usually 9 or more lower unbranched rays, rarely 8, while in S. mentella there are 8 or less rarely 9. In fishes which live off Iceland and in the Northwest Atlantic, there are on average more lower unbranched rays in the pectoral fin in S. marinus than in

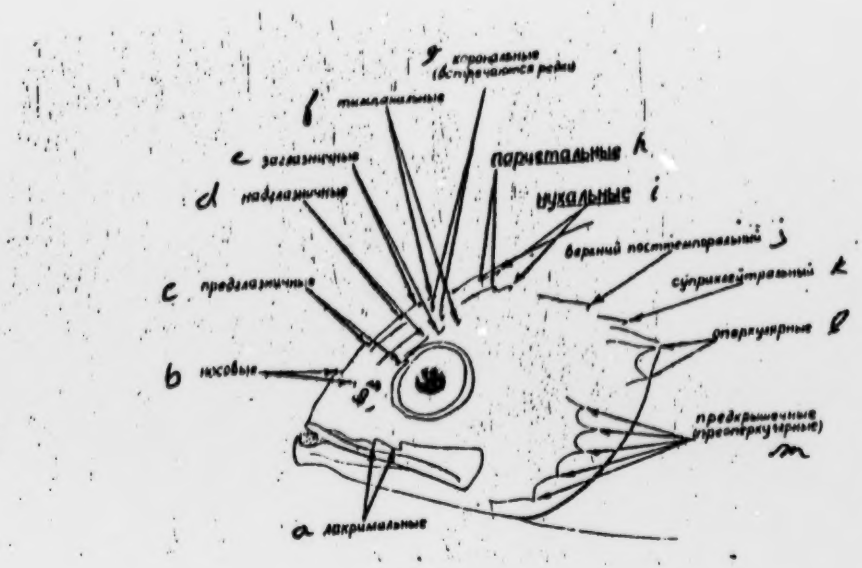

Fig. 5. Arrangement of spines on the head of North Atlantic species of redfish. The pterotical, lower posttemporal, subopercular and interopercular spines, which are very small and found very rarely or appear late, are not depicted.

a - lacrymal; b - nasal; c - preo_bital; d - supraorbital; e - postorbital;
f - tympanal; g - coronal (rarely found); h - parietal; i - nuchal;
j - upper posttemporal; k - supracleithral; l - opercular; m - preopercular.

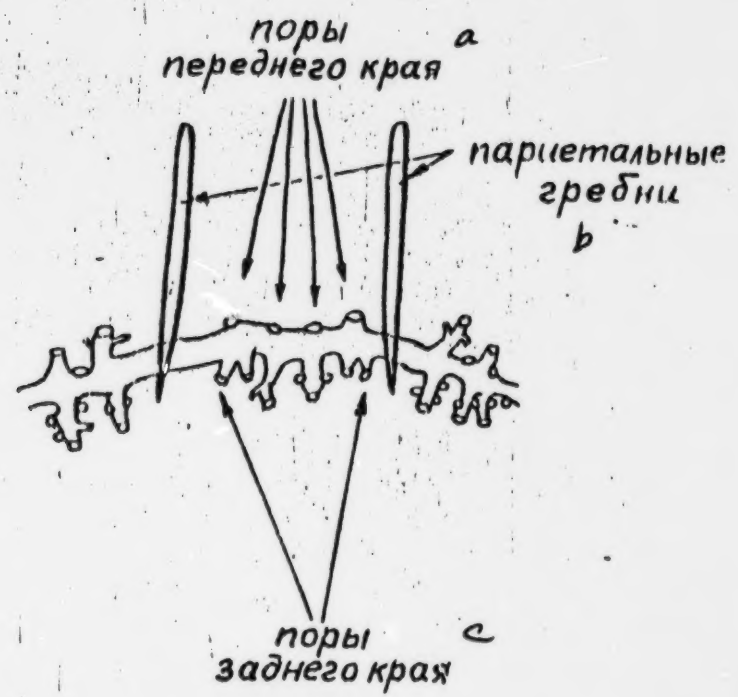

Fig. 6. Neuromasts of occipital commissure.

a - pits of anterior margin; b - parietal crests; c - pits of posterior margin.

S. mentella, but this difference is less pronounced.

The diameter of the orbit with identical length is on average smaller in S. marinus than in S. mentella, but the measurements overlap greatly, especially in shorter specimens.

That some characters overlap should not hinder the identification. Difficult cases should be noted, indicating control characters.

S. marinus is common in the southern part of the Barents Sea, off the coast of Norway, Iceland and Greenland. It is found much more rarely than S. fasciatus and S. mentella off the coast of North America. It is noted more often on the Northern and Great Newfoundland Banks, on Flemish Cape and in the Gulf of St. Lawrence; it is extremely rare south of Cabot Strait. It is found mainly at depths of less than 300-370 m, but is sometimes found at depths of 700-750 m.

S. mentella is distributed in practically all regions of /18
North Atlantic redfishspecies, except the North Sea and the Gulf of Maine. It goes further out to sea than the other species. It predominates markedly over other redfish species on the Kopytov and Rozengarten banks off Baffin Island. Adult specimens are usually found on the bottom at depths of 350-700 m; juveniles at lesser depths; it is caught up to depths of 1100 m. It is found in open water up to the 50 m horizon, and sometimes closer to the surface.

B. IDENTIFICATION OF FINGERLINGS WITH FORK LENGTH 5-12 CM

Fingerlings of this length are benthopelagic; they keep close to the bottom. Their vertical migrations have essentially not been studied yet

(daily vertical migrations are very typical of the adults of all North Atlantic species, except for S. viviparus, for which there is no information).

I. Discrimination of S. viviparus

As before, the best control character here is the number of oblique rows of scales (see s. 6). However, although the scales are more solidly set in S. viviparus than in the other species, they can still be stripped off.

In S. viviparus, there are most often 18 or less rays in the pectoral fin, 7 or less in the anal fin; there are 32 or fewer pits in the lateral line (not counting 1-2 pits on the caudal fin behind the base); there are 30 vertebrae. In S. marinus and S. mentella fingerlings, there are usually 19 or more rays in the pectoral fin; there are 31 (32) vertebrae. Deviations towards S. marinus and S. mentella in any one of these characters can be ignored. If there are two such characters, then such fingerlings must be noted, listing control characters.

In all the above-mentioned characters, except for the number of rays /19
in the pectoral fin (there are usually 19 in S. viviparus), S. viviparus fingerlings do not differ, or differ slightly, from S. fasciatus fingerlings. Counting the oblique rows of scales becomes important off Iceland and Greenland, where these species are found together.

The angle of inclination of the lower preopercular spine in S. viviparus fingerlings differs little from that in other species. Differences develop later: in S. viviparus, the preopercular spines, which at first unfold radially, point mainly backwards with growth.

II. Discrimination of S. fasciatus

In S. fasciatus, there are usually, 7 or fewer rays in the anal fin; the angle of inclination of the 3rd preopercular spine is less than 40°; the parietal and nuchal spines are separated on at least one side of the head; there are 30 or less vertebrae.

In S. marinus and S. mentella, there are usually 8 or more rays in the anal fin; the angle of inclination of the 3rd preopercular spine is more than 40°; the parietal and nuchal spines are fused; there are 31 or more vertebrae.

Specimens, in which only one of these characters does not match S. fasciatus, can be assigned to S. fasciatus. Individuals, with two such characters, must be noted along with the control characters.

In regions where S. marinus is absent or very rare, one can use still another character to differentiate the fingerlings of S. fasciatus from S. mentella fingerlings. With FL 5-12 cm, the length of the longest spine in the dorsal fin is more than 13% SL in almost all S. fasciatus fingerlings, but is less than 13% SL in almost all S. mentella fingerlings. The length of the spine should be measured from its base, which is buried in the skin, to the tip. /20

III. Separation of S. marinus and S. mentella

In S. marinus, the depth of the caudal peduncle with SL 4-6 cm is usually more than 7.6% SL, with SL 6-7 cm, more than 8.1% SL, and with SL 8-11 cm, more than 8.7% SL. The symphysial tubercle is still imperceptible, or a round tubercle is barely showing. With SL 4-5 cm, there are 2-4 neuromasts between the parietal crests on the posterior margin of the occipital commissure; with SL 8-12 cm, there are 4 pits on the anterior margin of this commissure.

In S. mentella, the depth of the caudal peduncle with SL 4-6 cm is usually less than 7.6% SL; with SL 6-7 cm, it is less than 8.1% SL; and with SL 8-11 cm, it is less than 8.7% SL. The rudiment of the symphysial tubercle, usually pointed, is noticeable. With SL 4-5 cm, there are 1-2 neuromasts between the parietal crests on the posterior margin of the occipital commissure; with SL 8-12 cm, there are 2-3 pores on the anterior margin.

The usual number of soft rays in the anal fin in S. marinus is 8; deviation on either side is usually no more than a few percents, although they may amount to several tens of percents in some specimens.

In S. mentella, specimens with 9 soft rays in the anal fin always make up 40-55% of all studied individuals, as do specimens with 8 rays (7 or 10 rays make up 2-3% or even less).

S. marinus and S. mentella fingerlings (FL 5-12 cm) differ very little in the angle of inclination of the 5th preopercular spine and the relative diameter of the orbit.

C. IDENTIFICATION OF FINGERLINGS WITH FORK LENGTH 2.5-5 CM

In this length range, smaller fingerlings, like the larvae, /21 are purely pelagic, not yet living on the bottom; those of larger sizes are benthopelagic. In the S. viviparus - S. fasciatus - S. marinus - S. mentella series, settling on the bottom takes place at increasing average length.

I. Discrimination of S. viviparus

In S. viviparus, there are usually 18 or less rays in the pectoral fin; there are only 10 or less rays in the anal fin, including future spines. Within this length range, in smaller individuals, the parietal spine is approximately equal in length to the diameter of the pupil, and the 3rd preopercular spine is twice as long as the pupil diameter (Fig. 7).

In other species, there are usually 19 or more rays in the pectoral fin. In smaller specimens, the length of the parietal spine is half or less the pupil diameter, while the length of the 3rd preopercular spine is approximately equal to the pupil diameter. In this length range, the spines grow shorter in all species and the difference between S. viviparus and other species at 3-4 cm is still unclear. Rays in the anal fin, inlcuding the future spines, usually number 11 or more in S. marinus and S. mentella.

II. Discrimination of S. fasciatus

In S. fasciatus, unlike S. marinus and S. mentella, rays in the anal fin usually number 10 or less, vertebrae 30 or less. By these two characters, one can discriminate only part of S. fasciatus fingerlings, with some small admixture of S. marinus and S. mentella, while a large part remains mixed. Specific characters for S. fasciatus fingerlings of this length range have yet to be found. /23

III. Discrimination of S. marinus and S. mentella

In S. marinus, the 3rd preopercular spine is longer than the 2nd preopercular spine from the top or these spines are of the same length; the snout is rather blunt (Fig. 3, 7).

In S. mentella, the 3rd preopercular spine is usually shorter than the 2nd; the snout is more pointed (Fig. 3, 7).

No other distinguishing characters are known as yet.

Some differences in the total number of rays in the anal fin - usually 11 in S. marinus, 11 and 12 in S. mentella, should be noted (see number of soft rays in larger specimens, section 6).

/22

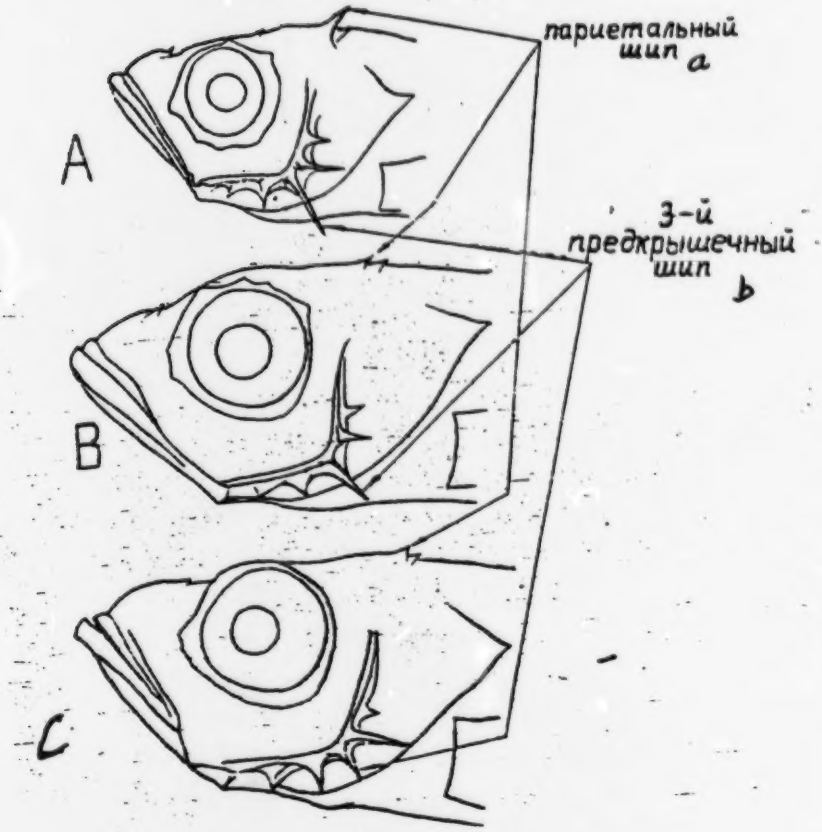

Fig. 7. Head of fingerlings. A - S. viviparus, AL 25.1 mm; B - S. marinus, AL 34.2 mm; C - S. mentella, AL 35.2 mm (after Yu. Magnusson). a - parietal spine; b - 3rd preopercular spine.

D. LARVAE WITH ABSOLUTE LENGTH 1.5-2.5 CM

I. Discrimination of S. viviparus

In S. viviparus, there are usually 18 rays in the pectoral fin; the length of the parietal spine is approximately equal to the diameter of the pupil; the 3rd preopercular spine reaches the base of the ventral fin or extends for most of the distance from the base of the spine to the base of the ventral fin; the coloring is yellowish-greenish.

In other species, there are usually 19 rays in the pectoral fin; the length of the parietal spine is half or less the diameter of the pupil; the 3rd preopercular spine falls short of the base of the ventral fin by its own length or more; the coloring is greyish.

II. Discrimination of S. fasciatus /24

In S. fasciatus, the length of the parietal spine is approximately half that of the pupil diameter. Small additional spinelets are not to be seen at the bases of the preopercular spines. There is no dark pigment on the isthmus, near the posterior-lower margin of the orbit and at the base of the anal fin. The coloring is yellowish-greenish.

In S. marinus and S. mentella, the length of the parietal spine is several times less than the pupil diameter; a small additional spinelet is set at the base of at least some of the preopercular spines; dark pigment can be seen on the isthmus, near the posterior-lower margin of the orbit and at the base of the anal fin; the coloring is greyish.

III. Discrimination of S. marinus and S. mentella

Still not possible. It is still necessary to find distinguishing characters.

E. LARVAE WITH ABSOLUTE LENGTH 1.0-1.5 CM

I. Discrimination of S. viviparus

In S. viviparus, the length of the parietal spine is approximately equal to the pupil diameter, while that of the 3rd preopercular spine is equal to the diameter of the orbit; there is a group of melanophores at the tip of the snout, as well as scattered melanophores at the base of the pectoral fin.

In other species, the length of the parietal spine is markedly less than the pupil diameter, while that of the 3rd preopercular spine is markedly less than the diameter of the orbit; there is no more than a single melanophore on the tip of the snout, but usually there are none yet, even at the base of the pectoral fin.

II. Discrimination of S. fasciatus

In S. fasciatus, the melanophores usually extend along the entire surface part of the dorsum. In larger specimens, the length of the /25
parietal spine is at least half the pupil diameter; there are 5 preopercular spines.

In S. marinus and S. mentella, a surface free of melanophores remains in the anterior part of the dorsum; the length of the parietal spine is several times less than the pupil diameter; there are still no more than 2-3 preopercular spines.

III. Discrimination of S. marinus and S. mentella

Still impossible; distinguishing characters must still be found.

F. EARLY LARVAE, PROLARVAE AND EMBRYOS IMMEDIATELY BEFORE LAYING

S. viviparus embryos emerging from eggs usually reaach an AL of 4-5 mm; S. fasciatus 5-7 mm; S. marinus 6-8 mm; S. mentella 7-9 mm.

I. Discrimination of S. viviparus

In S. viviparus, 1-4 melanophores are situated under the notochord at the base of the caudal part of the fin fold (subcaudal melanophores, Fig. 8), while there are 18-29 melanophores in the ventral row. Not only are the dorsal and lateral sides of the coelom pigmented, but so, though less densely, is the ventral side. In larvae more than 6 mm long, there is a group of melanophores on the tip of the snout, as well as at the base of the pectoral fin.

In the other species, there are no melanophores under the notochord, or, if there are, there are 26-42 melanophores in the ventral row. The ventral side of the coelom is not pigmented. There is no more than a single melanophore at the tip of the snout, but usually there is none, just as at the base of the pectoral fin.

II. Discrimination of S. fasciatus

In S. fasciatus, there are most often 2 subcaudal melanophores, /27 sometimes more, very rarely 1, and 26-42 melanophores in the ventral row.

In S. marinus and S. mentella, there are no subcaudal melanophores or in S. marinus there is occasionally 1 such melanophore (this has been noted only off North America). There are 5-24 melanophores in the ventral row.

With growth of larvae, the ventral row of melanophores gradually becomes increasingly indistinct, this process occurring more quickly in S. marinus and S. mentella than in S. fasciatus.

III. Discrimination of S. marinus and S. mentella

In S. marinus, there are 9-24 melanophores in the ventral row and 8-21 in the dorsal row; the melanophores in the dorsal row are situated

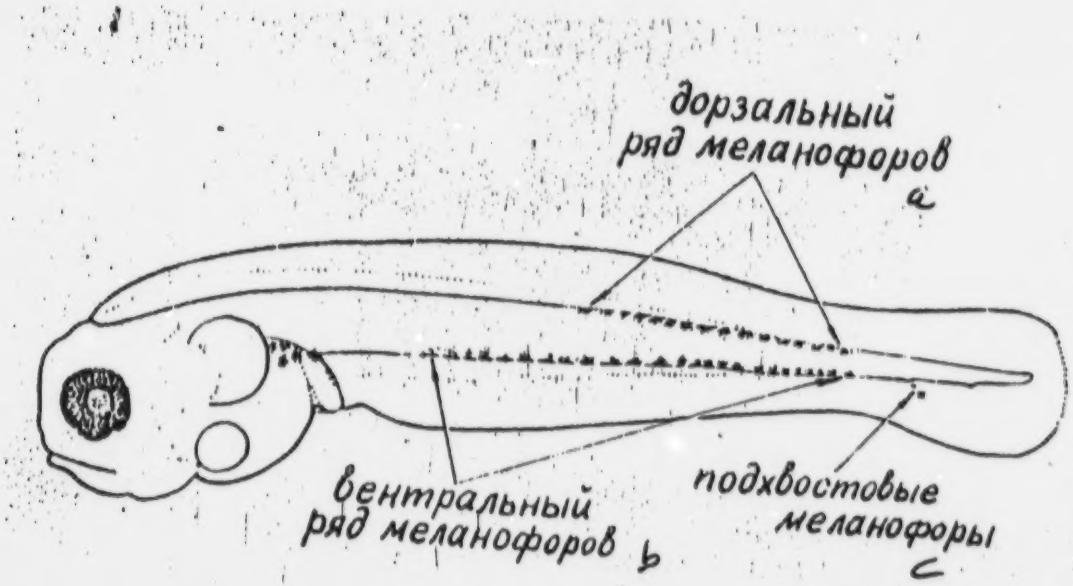

Fig. 8. S, viviparus embryo before laying 5.8 mm (after Toning, 1961).

a - dorsal row of melanophores; b - ventral row of melanophores; c - subcaudal melanophores.

above the last 13 myomeres or over most of them.

In S. mentella, there are 5-10 melanophores in the ventral row and 5-10 again in the dorsal row; the melanophores of the dorsal row are situated above the last 6-12

In identifying larvae and early fingerlings, a creative approach is especially required. In the early stages, the structure of the fish changes markedly and quickly. In some length ranges, control characters have still not been found for a number of species, or they are few. We must pay careful attention to changes in morphological characters with growth of larvae and fingerlings, starting at hatching, in a large number of individuals, to verify the control characters cited above and to find new ones.

In biochemical and other analyses, species must be compared in /28 individuals in which all morphological characters without exception are characteristic. Individuals in which any of the control characters deviate must be investigated separately.

It must also be kept in mind that there may exist two different forms of S. marinus: in one, the symphysial tubercle is the least developed and rounded, the maximal fork length of individuals is 1.0 m; in the other, the tubercle is better developed (although still not as much as in S. mentella), and is more or less pointed, and the maximal length of individuals is no more than 60 cm. No one has as yet studied this question seriously.